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STRUCTURAL DESIGN BASIS REPORT
OF PROPOSED RESIDENTIAL BUILDING AT
NANGANALLUR, CHENNAI.

STRUCTURAL CONSULTANT

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STRUCTURAL DESIGN REPORT

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1. Introduction

The proposed residential building at Nanganallur. It is RCC building, with Slit + 5 floors structure. The foundation of the building is adopted as Isolated foundation and SBC adopted is 240 kN/m^2 as per soil report.

2. Structural System

The structural system chosen for the buildings consists of slab and RCC Frames at appropriate locations. RCC columns and beams have been laid out in plan in coordination with architectural and services drawings.

3. Design Codes

The RCC design has been based on provisions laid down in IS: 456-2000 - General Construction in plain and reinforced concrete - Code of practice, following Limit state philosophy.

Other codes of practice to be referred to are as follows:

1. IS 875-1987 Part (I to IV) code of practice for design loads (Other than Earthquake) for buildings and structures..
2. IS: 1084-1985 Design and construction of shallow foundations in soils
3. IS: 1904-1986 Design and construction of foundations in soils General Requirements
4. IS: 456-2000Code of practice for plain and reinforced concrete.
5. IS: 8009-1976 Calculation of settlement of shallow foundation.
6. IS 3370- Part I, II, III, IV for water retaining structures.
7. IS:1905 Code of practice for Structural use of masonry
8. SP 24 : Explanatory hand book on IS 456
9. SP 34 : Hand book on concrete reinforcement and detailing.

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10. SP 16 : Handbook on Design Aids for Reinforced concrete to IS 456-1978.

11. SP 20 Explanatory Hand book on Masonry code

12.IS 1893 :2002 Criteria for Earthquake Resistant design of structures.

13. IS 13920: 2016 Ductile Detailing of R.C structures subjected to Seismic forces.

4. Materials

4.1 Grade of Concrete

The Indian Code IS:456-2000, permits a minimum grade of concrete for reinforced concrete members as M 25 and the following Concrete Grades have been used for various Structural Elements.

a) M-25 grade concrete has been used for foundation and columns
b) M-25 grade concrete has been used for plinth beam
c) M-25 grade concrete has been used for beams above plinth level. All concrete shall be conforming IS: 456-2000.

4.2.Reinforcement

All reinforcement bars to be used in the structural elements shall be High Yield Strength Deformed Thermo-Mechanically Treated bars with yield stress of 550 MPa and minimum elongation of 18.0% conforming to IS:1786-1985.

5. Cover to reinforcements

Minimum values for the nominal cover to be provided to all reinforcement, including links of normal weight aggregate concrete depend on the condition of exposure and minimum specified period of fire resistance.

Environmental exposure conditions considered are 'moderate' for sub structure, and 'mild' for superstructure. Minimum fire rating considered is four hours for columns, two hours for beams and one hour for slabs. Clear cover to the main reinforcement in the various structural elements depends on above criteria shall be :

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a)	Footings (Bottom)	50 mm
	Footings (Top and Sides)	75 mm
b)	Columns	40 mm
c)	Beams	25 mm or bar diameter whichever is greater
e)	Slabs	20 mm
f)	Staircase waist slab	20 mm
g)	Water tank walls and slabs	30 mm

6. Loads

6.1 Dead Loads

Following unit weights of building materials have been considered in accordance with IS:875 (Part I)-1987 and IS:1911.

Reinforced cement concrete	:	20 kN/m^3
Brick masonry	:	19kN/m^3
Light Weight Filling in Sunken area	:	10kN/m^3
Cement mortar / plaster	:	20kN/m^3
Floor finish	:	20kN/m^3
Brick bat for terracing	:	20kN/m^2

6.2 Live Loads

Following live loads have been considered in design in accordance with IS:875 (Part II)-1987.

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All floors	:	2kN/m^2
Staircase & lobby, library	:	3kN/m^2
Terrace floor	:	1.5kN/m^2
Seismic Zone	:	Zone III

7. Load Combinations

The building shall be designed for following Load Combinations as indicated in IS:456-2000. The various loads are combined in accordance with the stipulations in IS: 875 (Part 5) - 1987.

a) 1.5 x (Dead load + Live load)

The below load combination are used to check the structure in serviceability condition.

b) 1.0 x (Dead load + Live load)

8. Analysis Procedure

The framing systems (including the sizes of various structural elements) have been worked out, on the basis of a preliminary structural analysis and also in co-ordination with relevant architectural & services requirements.

Space frame analysis using STAAD PRO software has been undertaken to obtain refined results for all load combinations with IS code.

9. Design Methodology

The RCC design shall be based on provisions laid down in IS: 456-2000: Code of practice for plain and reinforced concrete, following Limit state philosophy. Structural design for typical members has been done for the combination of loads that produces maximum stress in the structural elements, and in turn requires maximum reinforcing steel provisions. The design of Slab and Isolated foundation is done in Excel Worksheets. The RCC design of Beams, Columns is done in STAAD PRO.

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10. Serviceability Requirements (Control of Deflection)

In order to control deflection of structural elements, two alternative methods in the Serviceability Limit State Design are envisaged in Indian Code. The first is by way of calculating the actual deflection as per clause 23.2 (a), (b) of IS:456-2000 and restricting it to specified values. The second method envisages "deemed-to-satisfy"provisions such as limiting the span / depth ratio as per clause 23.2.1 ofIS:456-2000.

The structural design shall satisfy the following requirements of limit state of serviceability:

a) IS: 456-2000 limits final deflection of slab or beam from as cast level to L/250, L being the effective span of the member. The deflection after erection of partitions and completion of finishes is limited to lesser of L/325 and 20 mm.

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APPENDIX –I

DESIGN CALCULATIONS

DESIGN OF FOUNDATIONS

PROPOSED RESIDENTIAL BUILDING AT NANGANALLUR

Given Data:

Grid ID = **A 13**

Node no = **45**

Column / Pedestal size

Breadth = **230** mm

Depth = **380** mm

Fck = **25** N/mm^2

Fy = **550** N/mm^2

Axial Load

Px = **534** kN

Calculations:

Step 1:

Total load **P** = **561** kN

Safe bearing Capacity of Soil SBC = **240** kN/m^2

Step 2:

Area of the footing

Total load / SBC **A** = **2.34** m^2

Equal spacing in both direction as 'x'

x req = 613 mm

X pro = 610 mm

Size of Footing Required

L = 1.60 m

B = 1.45 m

Provided

B = **1.68** m 5.5 ft

L = **1.68** m 5.5 ft

Net upward pressure **p** = **198.7** kN/m^2

< SBC Hence safe

Step 3:

Bending Moment calculation:

for per m strip **Mu**(Long) = 55.45 kN.m

Depth required

d reqd = 253.56 mm

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D prov	=	**380** mm
d eff	=	310 mm

Step 4:

Steel Ast calculation:

Ast req	=	384 mm^2
Select bar dia	=	10 mm
Spacing Required	=	204 mm c/c
Spacing Provided	=	150 mm c/c
Ast pro	=	523 mm^2

Step 5:

Check For Shear:

1. one way shear :

From Critical Xn for One Way Shear Vu		=	89.42 KN
	ζv	=	0.29 N/mm^2
	pt	=	0.169 %
	ζc	=	0.307 N/mm^2

ζv < ζc

hence safe in one way shear

2. Two way shear :

From Critical Xn for Two Way Shear Vu		=	474.61 KN
	ζv	=	0.62 N/mm^2
ζc= k*0.28*sqrt (fck)	ζc	=	1 N/mm^2

ζv < ζc

Hence safe in Two-way shear

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DESIGN OF COLUMNS

PROJECT NAME	**Residential Building at Nanganallur**	DOCUMENT No. 01	DATE 27.11.2024
PROJECT No. **C24168**	Column design GRID- A13	DESIGNED **DE** CHECKED **DJ**	PAGE

1.0 Input data

Height of column	H	=	3000 mm
Shallower depth of beam	D_{be}	=	300 mm
Depth of column	D	=	380 mm
Breadth of column	B	=	230 mm
Clear cover		=	40 mm
Diameter of bar	d	=	16 mm
No. of bars		=	4 No.s
Lateral ties diameter		=	8 mm
Effective length factor	α	=	1.0
Axial Load (Factored)	Pu	=	800 kN
Moment about major axis (Factored)	Mx	=	10 kN.m
Moment about minor axis (Factored)	My	=	9 kN.m
Characteristic strength of concrete	f_{ck}	=	25 N/mm^2
Characteristic strength of steel	f_y	=	550 N/mm^2

2.0 Design calculation

Unsupported length of column	l	=	2700 mm
Effective length of column	l_e	=	2700 mm

2.1 Slenderness Limit

Slenderness limit 60 times least lateral dimension = 13800 mm

With in Slenderness limit

Slenderness ratio in major axis l_{ex} / D =2700/380 = 7.1

lex/D< 12, Short compression member in major axis

Slenderness ratio in minor axis l_{ey} / B =2700/230 = 11.7

lex/B< 12, Short compression member in minor axis

Additional moment for major axis	M_{ax}	=	**0 kN.m**
Additional moment for minor axis	M_{ay}	=	**0 kN.m**

2.2 Minimum Eccentricity

At major axis		=	20 mm
At minor axis		=	20 mm
Minimum moment at major axis	Mminx	=	16 kN.m
Minimum moment at minor axis	Mminy	=	16 kN.m
Calculation of Pu/ f_{ck}BD =(800×1000)/(25×380×230)		=	0.37
Design moment + Additional moment	Mx	=	16 kN.m
Design moment + Additional moment	My	=	16 kN.m

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PROJECT NAME	**Residential Building at Nanganallur**	DOCUMENT No. 01	DATE 27.11.2024
PROJECT No. **C24168**	Column design GRID- A13	DESIGNED **DE** CHECKED **DJ**	PAGE

2.3 Calculation Compression Reinforcement

Assume Percentage of Reinforcement		=	1.0 %
p / fck		=	0.08
Pu / fck BD	=800×1000/(25×380×230)	=	0.37
Reinforcement distributed equally on two sides			
$M_{ux1} / f_{ck} BD^2$		=	0.18
$M_{uy1} / f_{ck} DB^2$		=	0.14
Moment carrying capacity about X axis	M_{ux1}	=	149.5 kN.m
Moment carrying capacity about Y axis	M_{uy1}	=	70.4 kN.m
$P_{uz} = 0.45 f_{ck} A_c + 0.75 f_y A_{sc}$		=	1344 kN
P_u / P_{uz}			0.60
α_n			1.00
Criteria for Biaxial bending			
$(M_{ux}/M_{ux1})^{\alpha n}$ + $(M_{uy}/M_{uy1})^{\alpha n}$		=	0.33
			<1
Area of compression steel Required			874 mm^2
Area of compression steel Provided			804 mm^2

2.4 Transverse reinforcement

Diameter of transverse Reinforcemnt	=	8 mm
Spacing of lateral ties		
a. Least lateral dimension of column	=	230 mm
b. 16 times the smallest dia. Of longitudinal steel	=	256 mm
c. 300 mm	=	300 mm
Reqd . Spacing of ties Min. above value	=	230 mm

Provide 8 mm dia. Ties @ 150mm c/c.

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DESIGN OF PLINTH BEAM

PROPOSED RESIDENTIAL BUILDING AT NANGANALLUR

Input Data: Beam No : Plinth beam 103 Grid -A14 B14

Breadth		B	=	230 mm
Overall Depth		D	=	380 mm
Clear Cover		d'	=	25 mm
Effective Depth		d	=	334.5 mm
		fy	=	550 N/mm^2
		fck	=	25 N/mm^2
Sagging Moments		Mu	=	20 kNm
End moments	LHS	M1	=	30 kNm
	RHS	M2	=	30 kNm
Shear at	END	Vu	=	36 kN
	K	Mu/(bd^2)	=	**1.17** Mpa

The section is Singly Reinforced Xn

Design Calculation:

Step 1:

For Sagging moments

Mu	=	20	kNm
k = (Mu/bd^2)	=	0.777	Mpa
Ast required	=	130	mm^2
Ast min	=	119	mm^2
Choose dia of bar 16mm Nos req	=	0.6	Nos
Dia	=	16	mm
No	=	1	Nos
Ast provided	=	201	mm^2

Provide 1Y16 as Bottom Steel Reinforcement

Step 2:

For End moments ***LHS***

Mu	=	30	kNm
k = (Mu/bd^2)	=	1.166	Mpa
Ast required	=	198.786	mm^2
Ast min	=	119	mm^2
Choose dia of bar 16mm Nos req	=	1	Nos
Dia	=	16	mm
No	=	1	Nos
Ast provided	=	201	mm^2

Provide 1Y16 as Top Steel Reinforcement at LHS

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Step 3:

For End moments ***RHS***

	Mu	=	30	kNm
	k = (Mu/bd²)	=	1.166	Mpa
	Ast required	=	198.786	mm²
	Ast min	=	119	mm²
Choose dia of bar 16mm	Nos req	=	1	Nos
	Dia	=	16	mm
	No	=	1	Nos
	Ast provided	=	201	mm²

Provide 1Y16 as Top Steel Reinforcement at RHS

Step 4:

Top Steel @ Middle

(20% of Max.Mt)	Ast required	=	40.2	mm²
Choose dia of bar 16mm	Nos req	=	0.2	Nos
	Dia	=	16	mm
	No	=	2	Nos

Provide 2Y16 as Top Steel Reinforcement at Middle

Step 5:

Shear Reinforcement

	Vu	=	36.000	kN
	ζv	=	0.468	N/mm²
	pt	=	0.230	%
	ζc	=	0.350	N/mm²
	ζc max	=	4.000	N/mm²
			0	

If,

i.ζv <ζc mini shear , Here.,

ii.ζc <ζv >ζcmax design shear., **DESIGN SHEAR REQD**

iii.ζv >ζcmax Increase Depth.

choose No.of Le: 2 and Choose dia of ba 8

	Asv	=	100.531	mm²
Design Shear Force	Vus	=	9.07275	kN

Spacing of shear reinforement as per

i. Mini Shear Reinf	Sv	=	523	mm
ii. Design shear-Vertical Stirrup	Sv	=	1773.53	mm
iii. Maximum spacing 0.75xd	Sv	=	250.875	mm
iv. Not greater than 300mm	Sv	=	300	mm

whichever is less

Provide 2 Legged Y8@150c/c

Step 6:

Results

Beam No	Size	Bottom steel		Top steel			Stirrups	
					at Support			
		Straight	Curtail	Middle	LHS	RHS	Ends	Middle
inth beam 103 Grid -	230X380	2Y16	_	2Y16	2Y16	2Y16	LY8/15(	LY8/23(

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APPENDIX –II



our services doesn't just end there

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